Weed Management

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Introduction

Weeds are any plants growing in the wrong place. For apple orchards, this usually means plants growing directly under the trees. Most apple orchards benefit from a grass sod between the rows, but some of the plants that establish in the grass, such as dandelions, may be undesirable.

Weeds are a concern because they rob moisture and nutrients from the trees. Some weeds may also be alternate hosts of diseases, e.g., black rot of apples, or of other pests such as nematode, tarnished plant bug on chickweed. Interference from weeds (e.g., tall weeds at harvest, discomfort from poison ivy, stinging nettles, or thistles) may also cause labour inefficiencies.

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Biology

It is easy for most growers to distinguish between broadleaf weeds and grassy weeds. Beyond this distinction, it is important to know the growth habit of the weed. Determine that growth habit your weed has: annual, biennial, or perennial.

Annual weeds usually grow and flower in one year. Many weeds in fruit crops are winter annuals, i.e., they begin their growth in the fall, growing a rosette and producing their flower in the second year. *Biennial weeds* generally establish in their first year and flower in the second year.

Annuals and biennial weeds cause competition for nutrient and water as they grow under the trees.

After they flower, they usually die. However, the seeds they produce may cause problems for several years.

Perennial weeds live for many years, and generally establish from various types of root systems, although many will also spread by seeds. They usually flower every year as well as expand their root system, so can spread by both methods through orchards. Perennial weeds can be very competitive, especially if they grow in thick patches.

The following table lists some common orchard weeds.

Table 1. Common types of weeds in orchards.

Types of Weeds		
Annual	**Biennial**	**Perennial**
Pigweed	Buttercup	Quackgrass
Lambs-quarter's	Yellow Rocket	Thistle
Chickweed	Wild Carrot	Dandelion
Smartweed	Burdock	Poison ivy
Ragweed	Pepper grass	Plantain
Bromegrass		Milkweed
Crabgrass		Creeping Charlie
Barnyard grass		Wild grape

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Goals of Weed Management

The goal in controlling weeds in tree fruit orchards is **to maximize yields by suppressing weed competition during critical periods** of crop development. There may be some other reasons to control weeds outside of these critical periods such as: attractiveness for PYO customers, harvest efficiency, and reduction of weed seed banks. However, controlling weeds at these other times will not increase yields.

For apples, there are five critical periods of crop development:

1. flowering
2. fruit set
3. fruit enlargement
4. flower bud initiation
5. hardening off.

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Conditions during flowering, fruit set, fruit enlargement affect this year's crop; conditions during flower bud initiation will affect next year's crop. For tree fruit, this means that weed competition needs to be suppressed from bud break to July. During the fifth critical period, *hardening off*, some weak weed growth under the trees is acceptable, and may even help harden trees off.

It is important to understand that **weed suppression does not mean weed-free**. Suppression of weeds to prevent competition for moisture and nutrients is usually enough to maximize yield. Where irrigation is used and nutrient levels are high, trees will tolerate a higher level of weed competition as well. Research on the effects of weeds early in the season has shown the importance of controlling weeds early in the season to maximize growth, fruit size and yield. Weeds growing weakly after terminal buds have set, have much less effect on growth and yield.

For newly planted trees, the effect of weed competition on tree growth will be greater than for established trees. Research on newly planted trees shows how competitive weeds can be compared to hand-weeding or residual herbicides. Look at the reduction in tree growth caused by weed competition from May to July illustrated in Figure 4.

Figure 1. Weed competition (chickweed and shepherd's purse) in the beginning of the growing season robs trees of ground-applied nutrients.

For higher density planting, a good way to maximize tree growth is to maintain a weed-free area under the trees from planting until mid-summer.

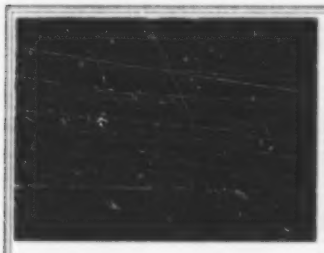

Figure. 2 Early weed escapes in the planting year compete with young trees for moisture and nutrients.

Figure 3. Improper or inadequate seeding of sod middles results in early weed problems in a young orchard.

Figure 4. An illustration of reduction in tree growth caused by weed competition in the first three months of a newly planted orchard.

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Weed Management Tools

Herbicides are just one of the tools available to control weeds in orchards. The use of cultivation, especially in the year of planting, mulching, and mowing are also important tools to control weeds. Each strategy has certain strengths and weaknesses as indicated in Table 2.

Table 2. Advantages and Disadvantages of Weed Management Strategies.

Tool	Advantages	Disadvantages
Cultivation	• Effective • Non-selective • Equipment readily available	• May damage soil structure • Spread perennial weeds • May damage trees/roots • Short term control
Mulching	• Effective • Non-selective • Holds moisture • Long-term control	• Availability of mulch • Cost of mulch/application • Attractive to rodents • May affect nutrition • Must be free of seeds
Mowing	• Rescue treatment • Quick suppression • Equipment available • Reduce seed spread	• Weeds may still compete • Quick regrowth • Several mowings required • May damage young trees
Herbicides	• Effective • Easy to apply • Can be selective • Timely	• Require 2% soil organic matter • Directed spray equipment • Effects on pest complex • Cost varies

Most weed management strategies will combine several of these tools, but it is important to be aware of the pros and cons of each of them:

Remember that using other tools of weed management may affect the performance of herbicides applied under your trees.

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How Herbicides Work

Herbicides registered for orchards kill weeds in many different ways (Table 3). Groupings of herbicides by mode of action are approved by the Weed Science Society of America, and listed in the OMAFRA Publication 75, *Guide To Weed Control* (Click here to order). Rotating to a herbicide with a different mode of action is a good strategy to manage weed resistance.

Table 3. Modes of Action of Herbicides and Their Advantages and Disadvantages

Type	Advantages	Disadvantages
Burnoff • kills top growth of existing vegetation	• Controls all emerged weeds • Inexpensive • Widely available • Can time for critical period.	• May damage trees if contacted • Weeds compete with trees • Weeds continue to germinate after application
Residual • stays in soil to kill germinating seedlings	• Reliable control • Effective for longer periods • Can time for critical periods. • Cost-effective • Broad-spectrum • Timing less important	• May cause tree injury • Avoid low organic matter soil • May have tree-age restriction • Residues after orchard removed • May require incorporation • Applied before weed problems are known • May affect soil biology
Selective • kills only certain weeds out of existing vegetation e.g., grasses or broadleaves - usually for weed escapes.	• Targets specific weeds • Minimizes herbicide use • Safe on trees.	• Does not control a broad spectrum of weeds • Often an extra application • More expensive • Timing is critical.

Once the soil surface is free of weeds, a residual herbicide will stay in the upper surface and control germinating weed seedlings.

Most of these herbicides are strong on either grasses or broadleaf weeds: tankmixes are usually designed to mix two herbicides with strengths on different weeds, so that the combination will control a wide spectrum of weeds.

Selective herbicides will be useful for rescue treatment, specific problem weeds like grass or vetch, or for reducing pressure from broadleaf weeds with fall treatments of 2,4-D. For growers wanting to use an Integrated Weed management approach (i.e., waiting until weeds appear before using herbicides), selective herbicides will be the desired approach.

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Issues With Using Herbicides

Managing Weed Resistance

There is concern that continuous use of the same herbicide will select resistant weeds. In orchard practice, this is likely not the case. Even though a triazine herbicides (Princep/simazine) has been used annually, the weed escapes in orchards are usually those species that simazine does not control well e.g., pigweed and crabgrass. Because other herbicide modes of action are often used, e.g., Roundup, Ignite or Gramoxone, and resistant weeds are killed by these treatment.

However, with the new herbicides that are now available to apple growers, it is possible to choose different herbicide families, and modes of action. Try to plan to rotate herbicides within a year, and between years in each orchard block.

Figure 5. Triazine-resistant weeds, like this pigweed, offer really challenges in weed management.

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Contamination of Surface and Ground Water

Many herbicides are water-soluble, and can be leached through the soil profile, eventually reaching the ground water. Heavy rainfall or irrigation immediately after application may cause this problem. Herbicide spills near well may also contaminate ground water. Avoid these situations.

Residual herbicides such as simazine that bind tightly to soil particles may be washed into surface water when erosion of soil occurs. Practice erosion control if your orchard site is at risk of wind or water erosion.

Remember that any herbicide that is lost through leaching or erosion is not giving weed control in your orchard!

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Managing Spray Drift

As a spray applicator, growers are required by the *Pesticides Act* to ensure that no pesticide lands off the intended target. There are two types of spray drift that should be avoided:

- physical drift - when tiny droplets (less than 100 microns) are moved by wind and air currents away from the target.
- vapour drift - when volatile products (e.g., 2.4-D_ become a vapour and move off target.

The Ontario Grower Pesticide Safety Course suggests 10 ways to reduce spray drift,

1. Don't spray - use cultivation, flamers, biological control if possible.
2. Use alternative application technology, e.g., wick wiper.
3. Read the label - directions for stage of growth, weather and other cautions.
4. Watch the weather - avoid winds over 10kph, temperatures above 25°C, and low RH (<75%).
5. Use buffer strips - check label; recommend at least one spray boom width.
6. Use high water rates - larger nozzles result in larger droplets and better spray coverage.
7. Use adjuvants with caution - check label; may distort spray pattern.
8. Lower the boom - use wider angle nozzles; watch topography and boom width/
9. Use anti-drift technology - nozzle hoods, boom hoods, perforated screen, air-assist/curtain.
10. Choose the right nozzles - drift reducing styles are now available.

Figure 6. Shields can be mounted to swipe weeds growing under trees, thereby preventing herbicide drift.

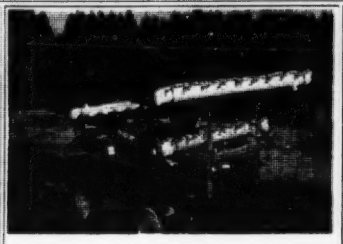

Figure 7. Wick wipers can be mounted to swipe weeds growing under trees - without tree contact or herbicide drift.

Figure 8. Mowers with wing arms can be used to cut weeds around tree trunks. A sensor will kick out the mower arm around the three to prevent mechanical injury.

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Effect of Herbicides on Non-Target Pests

Herbicides may affect things other than weeds. Some herbicides e.g., linuron are toxic to soil fauna like earthworms. Some insects like tarnished plant bugs thrive when weeds like chickweed or creeping Charlie grow under trees, and control of these weeds often reduce fruit damage from tarnished plant bug. Two-spotted spider mites live on the ground cover in the spring and overwinter, so removal of their hosts early in the season may reduce problems. However, if pests like tarnished plant bug or two-spotted spider mites are established on the ground cover in your orchard, and herbicides are used to kill the weeds, damage from these insects may increase as they move into trees to find food.

Use of herbicides like 2,4-D to control dandelions may affect bee activity during pollination time. Although honeybees appear to prefer apple blossoms to dandelions, bees may use dandelions to maintain their hive strength in spring when flying conditions are poor during apple bloom.

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Crop Safety

Soil organic matter - generally soils with at least 2% organic matter (OM) are required to use residual herbicides. For soils <2% OM, choose Devrinol because its crop safety is not dependent on OM. Since Sinbar tends to be less bound to soil particles, a soil OM of 3% is recommended to avoid crop injury. Mulch is also a good choice for low OM soils.

Age of trees - some herbicides are only registered for new trees. For Treflan, this restriction is because of the need to incorporate the product. For other products, there has not been research to prove there is no residue in the fruit. Some herbicides can only be used on older trees. For example, linuron is restricted to tree 10+ years old, because the original research was only done on trees 10 years old. In some cases, there is a need to wait until the trees have a larger root system or thicker bark to avoid tree damage.

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Herbicide Residues in Soils

For orchards that are scheduled for removal in the next three years, long residual herbicides should be avoided. Simazine (Princep, Simadex), Devrinol, and Sinbar should not be used for several years before orchards are removed.

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Soil Incorporation Requirement

Devrinol and Treflan require incorporation into the soil to prevent sunlight from breaking them down. For Treflan, cultivation with tillage equipment is required, restricting its use to newly planted trees. For Devrinol, incorporation by rainfall or irrigation must take place within two days in the summer or seven days in the late fall.

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Strategies for Integrated Weed Management (IWM)

Integrated weed management, like integrated pest management, is a multidisciplinary approach to controlling weeds in the orchard using chemical, biological and cultural techniques. The following strategies can be used in Ontario apple orchards:

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Pre-Plant

Managing weeds in orchards prior to tree planting will reduce weed problems later in the orchard's life. Use the pre-plant year to build organic matter with a green manure crop, that gives several opportunities to reduce weed pressure. Begin with a general burnoff treatment of Roundup after weed growth has begun. Plant the green manure crop, choosing one that will grow thickly and suppress annual weeds. If a grassy cover like cereal or sundan sorghum is used, a selective herbicide like 2,4-D can be used to control broadleaf perennial weeds like thistles. As well, wiper applications with Roundup targeted when the weed is most susceptible (Canada thistle at early flower bud, milkweed at flower bud, bindweed at full flower, quackgrass actively growing with at least 3-4 new leaves on each shoot) should be used. Where perennial weeds are present choose the higher rate of Roundup as on the label.

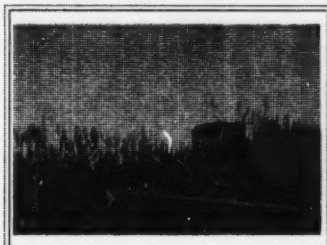

Figure 9. A green manure crop, like this Sundan X sorghum cross, can be incorporated in the fall prior to planting to suppress weeds and improve soil tilth.

Figure 10. Orchard sod can be established in the year prior to tree planting. Sod strips, where trees are to be planted, are treated with herbicide.

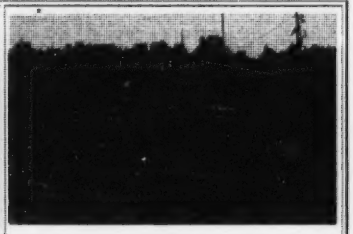

Figure 11. Properly maintained herbicide strips, just wider than the tree's drip line, eliminate weed competition.

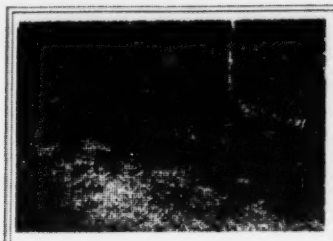

Figure 12. Grass clippings, blown under trees with a modified mower, makes an efficient and cheap mulch.

Figure 13. Black plastic mulch, installed at planting, controls weeds, conserves moisture, and warms the soil.

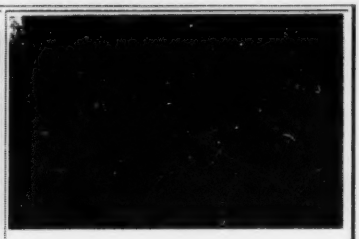

Figure 14. A well-established orchard sod with minimal weed growth. Note that allowing weed growth in herbicide strips late in the season may help trees "shut down" for winter.

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First Year of Planting

After planting the orchard in the spring, choose one of the residual herbicides registered for new plantings. This application usually gives eight to twelve weeks of weed control. Since there is little shading in young orchards, weed escapes are likely to begin in early summer. Either a selective herbicide (e.g., Fusilade or Poast) for grass could be used, or cultivation or hoeing can keep tree rows clean until late July. Weak weed growth under the trees by late summer will slow tree growth and help trees harden off for winter.

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Established Orchards

Early Season

Some weeds, like chickweed, usually begin growth early in the season before bud break. As an orchard matures, patches of perennial weeds begin to establish, and usually are growing by bud break as well. One of two strategies can be used.

- Wait for weeds to emerge and use a burnoff treatment, followed by mulching and/or a residual herbicide. If weed escapes begin before herbicide could be used.
- Apply mulch and/or one of the residual herbicides before weed growth begins. If weed escapes begin before the **critical period** of **fruit bud initiation** occurs (generally in early June when terminal buds set), it is important to control them. Your choice of herbicide depends on what kinds of weeds are present and how early in the growing season they appear.

Either strategy is acceptable if done in a timely manner that controls the weed competition from bud break through terminal bud set and fruit bud initiation.

Summer - there is some concern with using translocated herbicides like Roundup and Amitrol-T after June, because trees are moving stored reserves to their roots and may take the herbicide there too. However, these herbicides may be carefully used at this time with directional shielded sprays or wick wipers. This timing may be useful for perennial weeds like thistles or bindweed, that are most susceptible to there herbicides at early bloom.

Fall - fall applications of 2,4-D or Roundup directed away from the trees may be useful to control perennial weeds. Wait until useful fruit is removed from the orchard floor.

Weed escapes should have their flowers destroyed before weed seeds are allowed to spread. Mowers with swing arms that can reach under the trees are effective, especially if weeds are small and lush.

Tillage tools like the Weed Badger, (rotational finger weeders) are also effective if done every three to four weeks. Many implements have a sensor that will kick the equipment out around the trees to avoid damage.

Figure 15. Weed "escapes" can occur around trickle irrigation emitters due to leaching of herbicides.

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For more information... on weed management see Publication 75: Guide To Weed Control, this contains a wide variety of information on weed control. In addition to herbicide formulations, rates and remarks on usage, there is information on rainfast intervalor post-emergent products, winter storage, application technology, avoiding spray drift, herbicide residues, soil pH restrictions, and principles of preventative weed control.

For more information... on weed control in fruit crops see Publication 360: Fruit Production Recommendations, also contains a chapter on weed management for fruit growers, including herbicide rates, remarks and notes on each individual herbicide.

For more information... on general weed information check out the weed information on the OMAFRA weed pages. Factsheets, infosheets, list of noxious weeds and a weed identification quiz will boost your knowledge of weed management.

Also, for more information... on Integrated Pest Management in Apple Orchards, see Publication 310: Integrated Pest Management for Ontario Apple Orchards or contact Margaret Appleby

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